D 93434 **(Pages : 2)** **Name.....**

Reg. No.....

FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2020

(CBCSS)

Physics

PHY 1C 03—ELECTRODYNAMICS AND PLASMA PHYSICS

(2019 Admissions)

Time : Three Hours Maximum : 30 Weightage

General Instructions.

Section A

Eight short questions answerable within 7½ *minutes.*
Answer **all** *questions.*
Each question carries weightage 1.

1. Explain the Lorentz gauge condition for potentials.
2. State and explain Poynting's theorem.
3. Explain Snell's law of refraction in the case of oblique incidence at a plane dielectric boundary.
4. What are evanescent waves ?
5. Write down the time-harmonic transmission-line equations for phasors V (z) and I (z).
6. The magnetic field is zero in the particle's rest frame S_0. What is the value of magnetic field in a system S, moving with a speed v relative to S_0 ?
7. Give the stress tensor for plasmas in the presence of magnetic field.
8. Outline the criteria for plasmas.

(8 × 1= 8 weightage)

Section B

Four essay questions answerable within 30 *minutes.*
Answer any **two** *questions.*
Each question carries weightage 5.

9. Derive the time harmonic Helmholtz's equations for scalar potential V and vector potential A. What are its solutions ?
10. Obtain the instantaneous field expressions for TE modes in a rectangular waveguide of sides a and b.
11. Express the field tensor in terms of four vector potentials. Also, deduce the Maxwell's equation in potential form.
12. Derive the fluid equations of motion from the moments of Boltzmann equation.

(2 × 5 = 10 weightage)

Turn over

Section C

Seven problems answerable within 15 minutes.
Answer any **four** *questions.*
Each question carries weightage 3.

13. Express $(4 \cos \omega t - 3 \sin \omega t)$ as first (a) $A_1 \cos(\omega t + \theta_1)$, and then (b) $A_2 \sin(\omega t + \theta_2)$. Determine $A_1, A_2, \theta_1, \theta_2$.

14. Derive the relation between group velocity and phase velocity. Also, detail the conditions of dispersion.

15. Assume that a uniform plane wave in a lossless medium with intrinsic impedance η is incident normally onto another medium with intrinsic impedance ξ, through a plane boundary. Evaluate the expression connecting reflection coefficient and transmission coefficient.

16. Find the size of a hollow cubic cavity made of copper in order to have a dominant resonant frequency of 9 GHz. Also evaluate the quality factor at that frequency. ($\sigma = 5.8 \times 10^7$ S/*m*).

17. Prove that the current density vector, J^{μ}, is divergenceless.

18. Compute λ_D and N_D in the earth's ionosphere with ion concentration $10^{13}/m^3$ and kT_e from 0. leV to 0.01 eV.

19. Derive an expression for plasma frequency in the absence of magnetic field and thermal motion.

(4 × 3 = 12 weightage)